National Defense Center for Energy and Environment

Evaluation of Composting for Reducing Volume of Solid Waste on Contingency Bases

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Outline

- Contingency Base Solid Waste Issues
- Solid Waste Management Options
- Composting as a Possible Solution
- In-Vessel Technology
- Planned Demonstrations
- Conclusions
- Contacts & Questions

Solid Waste Issues

- Operational and maintenance burdens
- Regulatory and other compliance issues
- Safety and health issues
- Security issues
- Natural infrastructure demands
- Greenhouse gas emissions
- Tipping, transportation, and contractor costs

Waste = Liability

Contingency Base Non-Hazardous Solid Waste Management Options

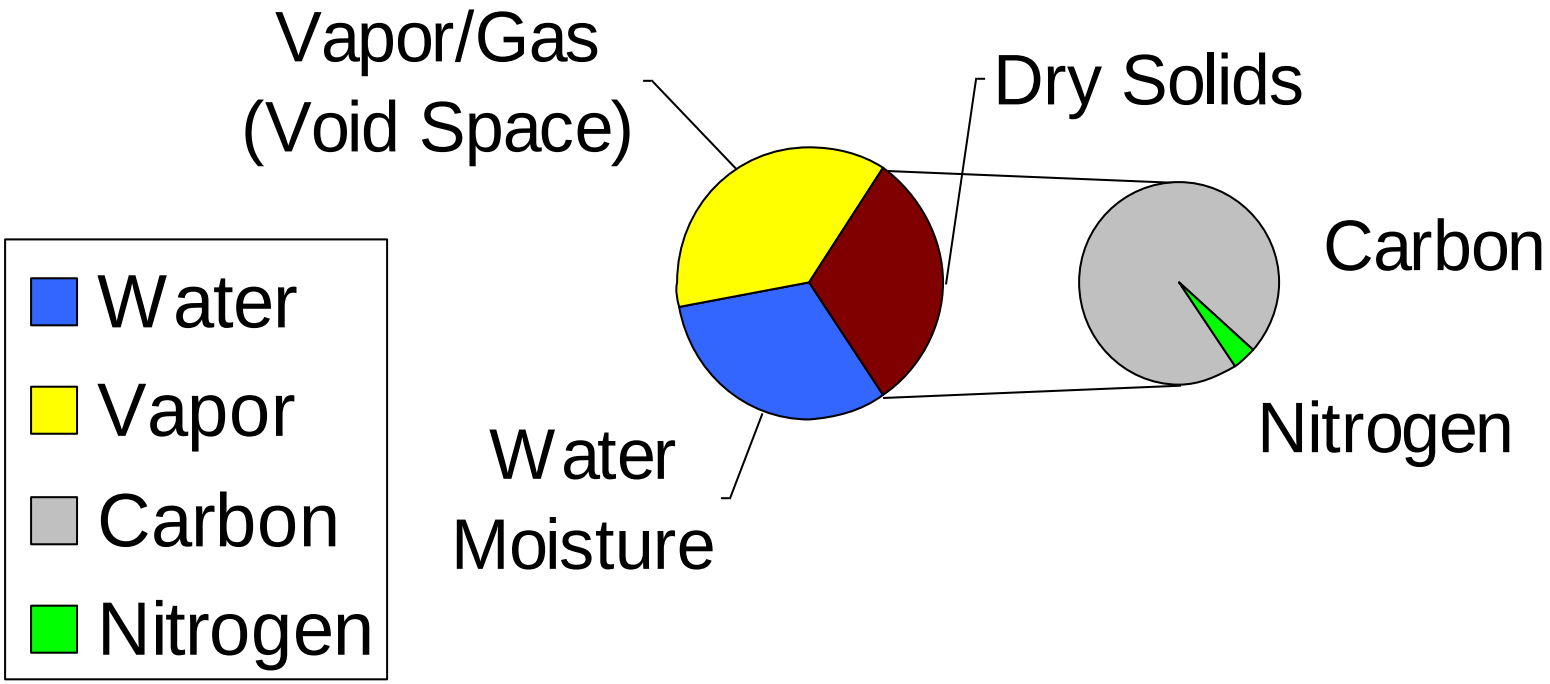
Option	Advantages	Disadvantages
Burial Landfill	Low Cost Low Maintenance Expedient, No Sorting	Large Footprint Impacts to Host Nation Leachate + Residual Liability
Open Pit Burn	Low Maintenance Expedient, No Sorting	High Cost – Fuel Large Footprint Impacts to Host Nation + Camp Leachate + Air Emissions Ash Sampling
Incineration Burn Box	Higher Burn Temperature Smaller Footprint No Sorting	High Cost – Fuel Mobility Issues Scaling and Capacity Issues Ash Sampling
Incineration Two Stage Burn	Higher Burn Temperature Smaller Footprint No Sorting	High Cost – Capital and Fuel Scaling and Capacity Issues
Waste-to-Energy	Higher Burn Temperature Useful By-Product Low Fuel Demand	High Cost – Capital High Maintenance, Operator Skill Level Requires Waste Sorting/Pre-processing Scaling and Capacity Issues Technology Readiness Issues
Composting	Useful By-Product Low Cost Low Energy Demand	Requires Waste Sorting Suitable for Certain Organic Wastes Only Scaling and Capacity Issues

What is Compost?

- An excellent soil amendment that adds stable organics and nutrients to improve the soil
- Natural fertilizer and valuable humus that promotes weed and erosion control, protects plant roots, improves drainage, and conserves water
- Potential fill material when closing site and returning to Host Nation

Raw Materials (Above)
Become Compost (Below)

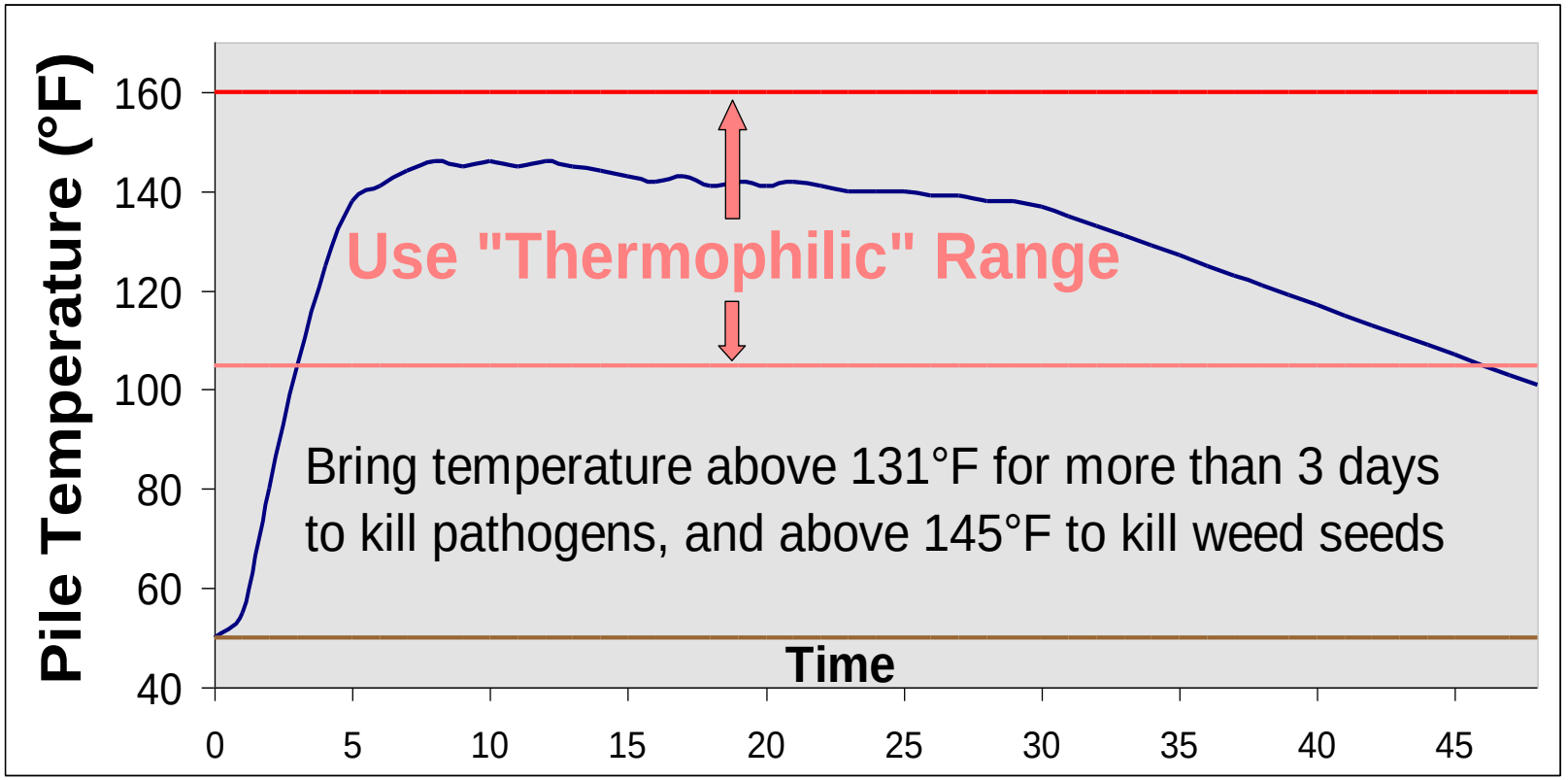
Desired Relationship of Raw Composting Mixes



Two other elements of composting used:
(1) heat, and (2) organisms (e.g., microbes)

The Temperature Factor

- The stage of the composting process can be tracked as the pile temperature rises and falls



Screening and Curing

- Screening classifies the compost particles
  - Bulking material screened from the compost may be reused to give the next pile its structure
- Curing
  - Nitrifying bacteria recolonize as the fresh compost pile cools to below 85°F and convert the unacceptable concentrations of ammoniacal-nitrogen to plant-available nitrate-nitrogen
  - If the fresh compost is to be bagged, then this process must be completed in a storage area on site

Types of Composting Processes

- Static solids piles
- Agitated solids “windrows”
- In-vessel systems
- Combinations of the above processes

Static Pile at Joint Base Lewis-McChord

Windrow at Fort Hood

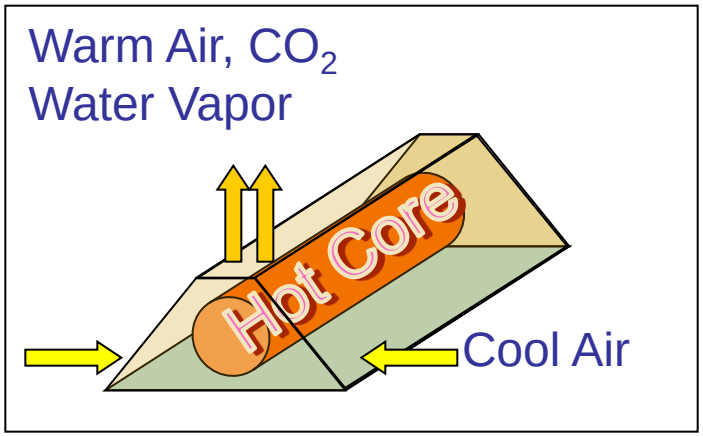


Illustration of “chimney effect”

In-vessel at Fort Irwin

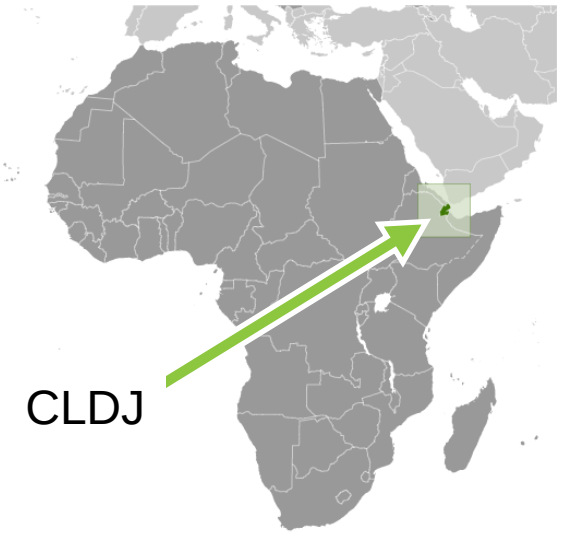
Desired Contingency Base Characteristics

- Increased flexibility in base camp operations
- Decreased construction/de-construction requirements
  - Time, material, equipment, personnel
- Improved operations management
  - Power, water, waste
- Improved design of major utility infrastructure
- Improved Environmental, Safety, and Occupational Health (ESOH) elements

Focus of NDCEE effort: Small- to Mid-size Contingency Bases

Army and Navy NDCEE Projects – Overview

- Overall objective to reduce the environmental and logistic footprint
  - System-of-systems approach
- Reduced Footprint Base Camps
  - Primary stakeholder Army Central Command (ARCENT)
  - Composting demonstration/validation
- Energy and Environmental Sustainment Support to Navy Camp Lemonnier, Djibouti, (CLDJ) Horn of Africa
  - Primary stakeholder Naval Facilities Engineering Support Center (NFESC)
  - Composting demonstration/validation



Technology Evaluation Criteria

- Energy Demand
- Throughput Capacity
- Mobility
- Capital Costs
- Personnel Requirements
- Land Footprint
- Maintainability/Reliability
- Procurement Lead Time

DTE ENVIRO-DRUM

EcoPOD
Ag-Bag Technology

CompTainers

HotRot System

Rocket® Composter

Composting Demonstrations

Leveraging of NDCEE and JBM-HH Objectives

- NDCEE Projects
  - Dem/Val mobile, containerized composting technology with low energy footprint and easy operation to enable safe reduction of organic solid waste at Contingency Bases
- Joint Base Myer – Henderson Hall (JBM-HH) Composting Project Drivers
  - Small land area and close proximity of other land uses
  - Reduce shipment of horse manure for land filling
  - Lower impact on The Old Guard Soldiers
  - Reduce overall costs
  - Generate compost as a soil amendment
    - Base and local use

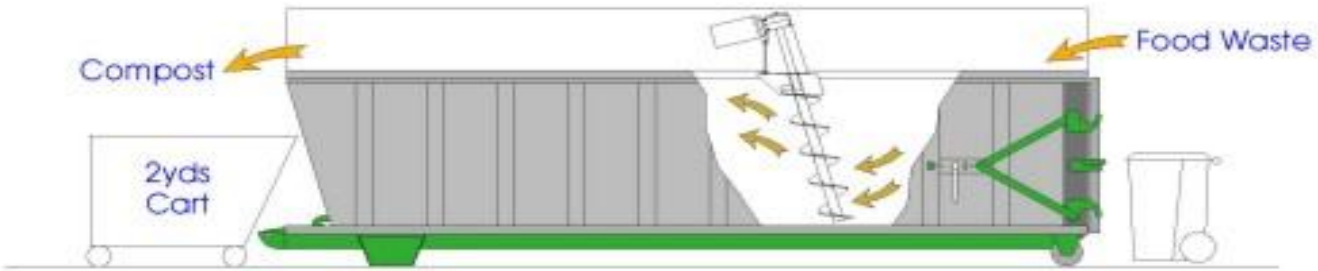
Leveraging of NDCEE and JBM-HH Objectives (cont.)

- Horse manure and shavings
  - Disposed in a 30 yard bin
  - Dumped every 2-3 days in a landfill
- 100 bags of shavings used each day
- Bedding Management
  - Agreed to switch from shavings to pellets
  - Reduces time spent cleaning stall

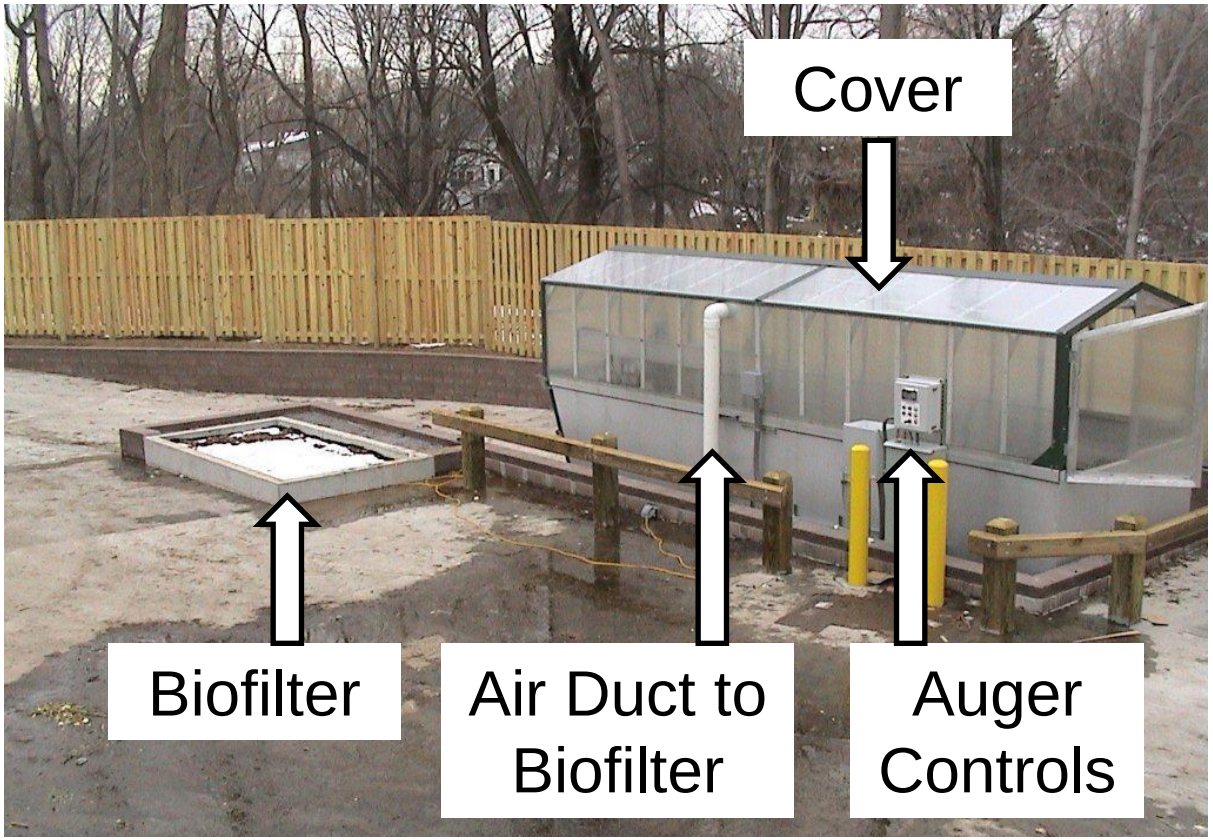
JBM-HH Horse Manure is to be Diverted from Landfill to On-site Composting

Selected Composting Technology: Green Mountain Technologies' Earth Flow

- Uses inclined auger
  - Automated movement, adjustable controls
  - Mixes and advances composting materials
  - Serrated flights assist decomposition
- Includes a cover over the bin
  - Exhaust gas to biofilter for odor control
  - Modulates temperature and moisture
- Made in U.S.A.



Example Install of Composter: Green Mountain Technologies' Earth Flow

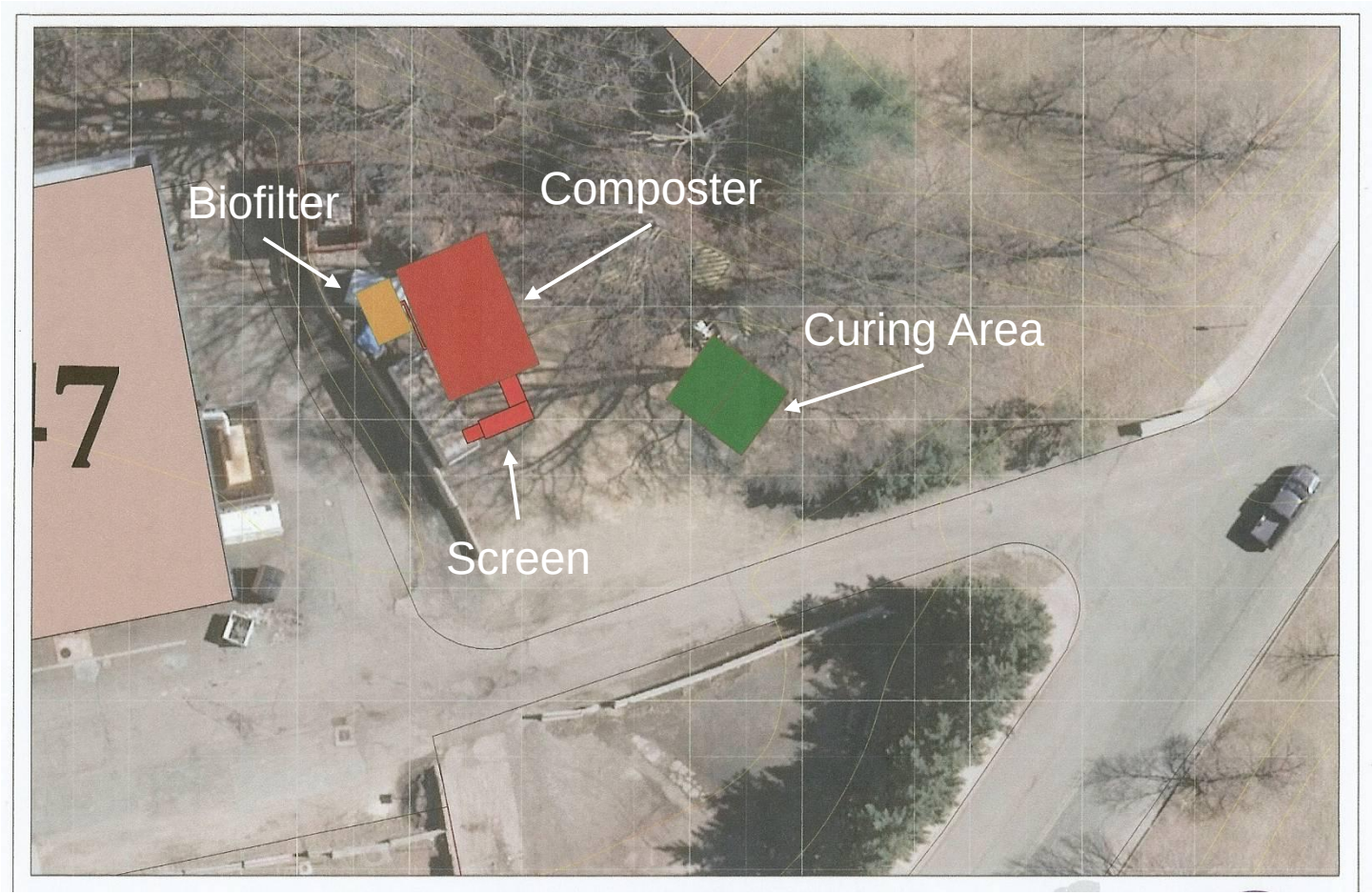


Load End

Discharge End

http://www.compostingtechnology.com/invesselsystems/earthflow/

Proposed Layout at JBM-HH



Materials Handling

- Transport
- Transfer
- JBM-HH Front Loader

Materials Mix, Two Scenarios

	JBM-HH Mix	Contingency Base Mix
Waste to be composted	**(yd^3/month)**	**(yd^3/month)**
Food waste	10	70
Manure mixed with bedding	75	0
Wood chips	5	5
Paper	0	15
Water	0	0
Urea	0.25 (400 pounds)	0
Total (3-week composter basis, yd^3/month)	90	90
Bulk Density((pounds/yd^3) (target less than 1,100 pounds/yd^3)	**782**	**419**
Moisture (weight percent) (target range is 50 to 60 percent)	**55**	**57**
Carbon:Nitrogen (weight ratio) (target range is 25:1 to 30:1)	**27:1**	**25:1**

Data Collection

- Feed
  - Volume of each type of feed
  - Labor requirements for operations
- Processing
  - Temperature of pile
  - Frequency of auger movement and electrical current draw
  - Labor requirements for operations and maintenance
- Discharge
  - Volume removed
  - Labor requirements for operations and maintenance
  - Solvita maturity
- Curing
  - Solvita maturity for on-site samples
  - United States Composting Council Seal of Testing Assurance (STA) compost quality sample
  - Labor requirements for operations

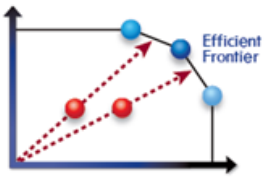
Camp Lemonnier Implementation Activities

- Evaluation of site-specific conditions and waste data
  - Diverting food waste from incinerator main driver
    - Saves fuel to burn wet food
    - Improves incinerator operation
    - Reduces ash generated for disposal
- Identification and analysis of technologies
  - In-Vessel composting
  - Possible future addition of biogas unit prior to composter
    - Uses dry fermentation or biodigestion
    - Low or no water addition reduces equipment size
    - Near-commercial for equipment size needs
    - Provides combined heat and power (CHP)

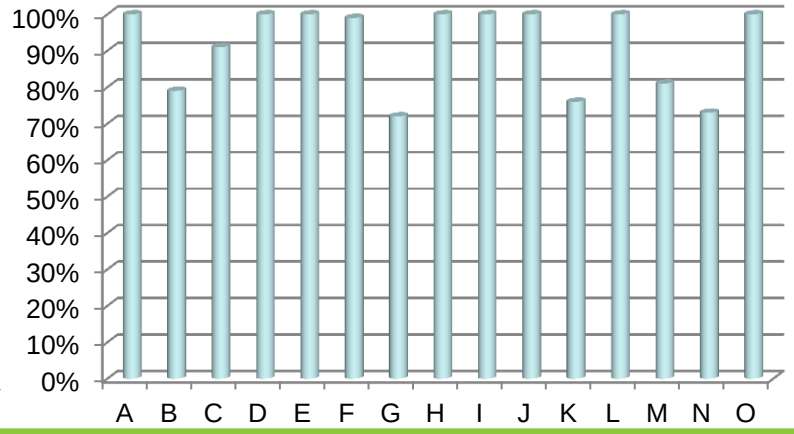
Developed Metrics and Scored Technologies

	INPUTS							OUTPUTS				
Technology	Capital Cost	Skilled labor	Unskilled labor	Energy Demand	Land Footprint	lead time	Material handeling requirements	Throughput Efficiency	Reliability	Mobility	Odor/ Nuisance	Mixture Flexibility
A	50,000	2	6	3	13,240	3	5	6	2	3	16	9
B	250,000	2	4	0	1,290	3	6	6	3	2	13	10
C	1,500,000	4	3	0	525	9	1	6	3	2	18	14
D	187,500	3	2	0	1,000	6	0	5	3	3	18	13
E	130,000	2	4	0	80	6	3	1	3	3	18	12
F	120,000	1	6	0	51	4	5	1	3	3	18	10
G	49,500	3	4	0	65	3	4	1	3	3	18	13

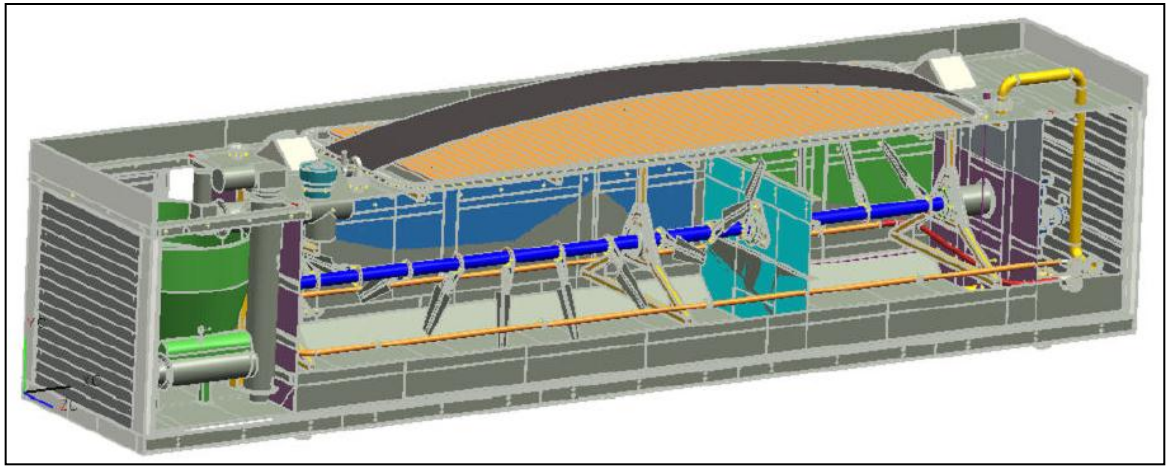
FASST™

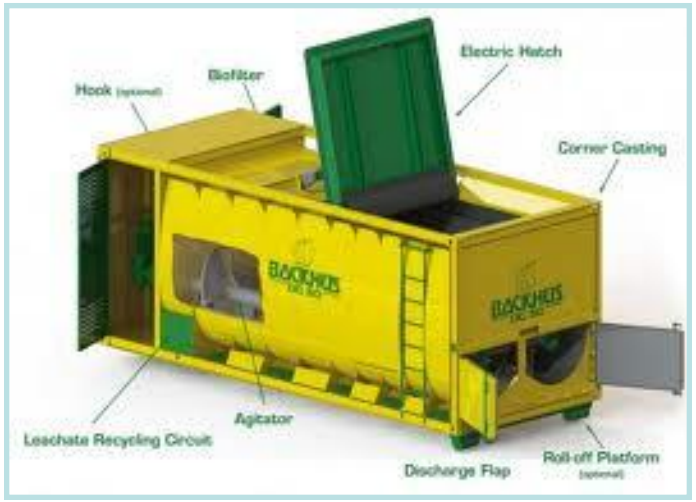


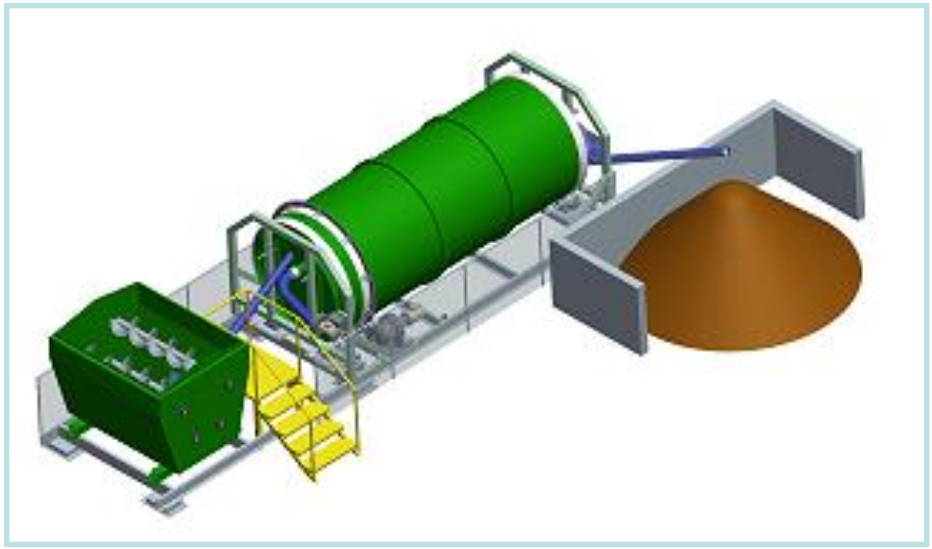
Identify Best Technologies



Digester-Composter Sequence Ranked High







Conclusions: Composting Solid Waste on Contingency Bases

- Diverts food and organic waste from incineration (+)
  - Lower fuel burden of camp
- Creates a usable product (+)
  - Erosion control
- Requires waste sorting (-)
  - Can only be supplement to other management approaches
- Requires operator training (-)
  - Proper mix of wastes, moisture and temperature
- Adapts to smaller-scale and mobile contexts (+)
  - Configuration (windrow v. in-vessel) depends on volume
  - Demonstration and validation needed
- Limits flexibility at demobilization (-)
  - Partially processed waste

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